Print Your Last Name [redacted] First Name KYLE

UNIVERSITY OF SASKATCHEWAN
COLLEGE OF ENGINEERING

ELECTRICAL ENGINEERING EE271.3

Midterm Examination
Part A

Instructor: S.O. Kasap
November 6, 2002
Time allowed: Part A is nominally 1 hour.
Total time allowed: 2 hours for Parts A and B.

Instructions: Closed book examination. *Answer any 2 questions from 4 questions.* If you answer more than 2 questions, only the first three will be marked. All questions carry equal marks. Marks for part-questions depend on the relative difficulty. All answers must be given in conventional units. All sketches must be clearly labeled and self-explanatory. Diagrams that are not properly and clearly labeled and are subject to ambiguity will be heavily penalized. Next to each diagram write short explanations that provide the key concepts and principles on which the diagram is based. Wrong concepts will be heavily penalized. State clearly all assumptions made in your derivations.

Important: You must hand in Part A before you can start Part B.

Note: You may spend more or less time on Part A; but the total exam time is 2 hours.

Question	Marks
1	24
2	23
3	
4	
5	
TOTAL	47/50

excellent work
Well done
SOK

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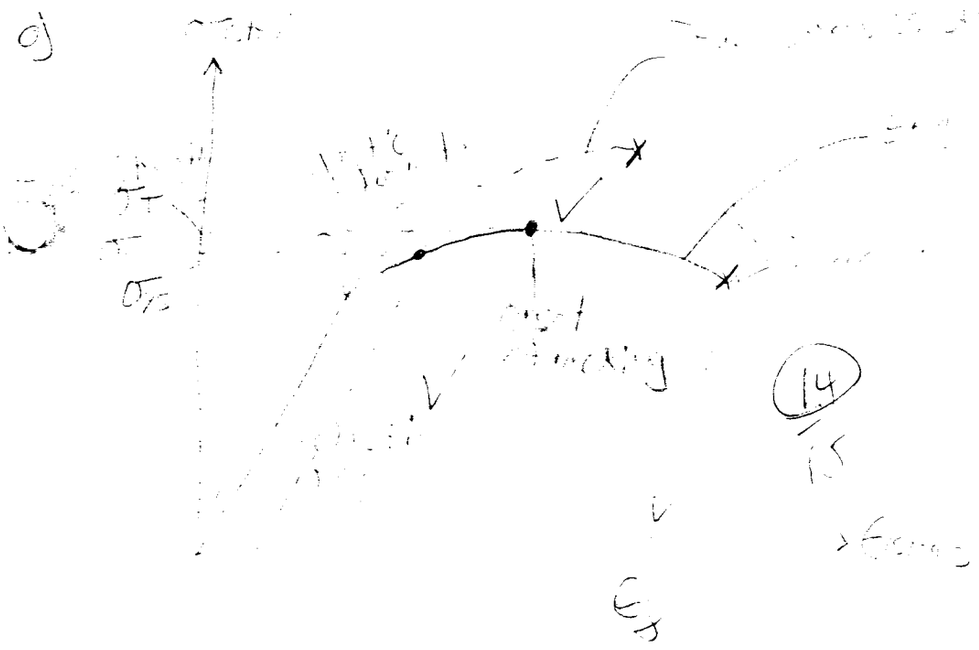
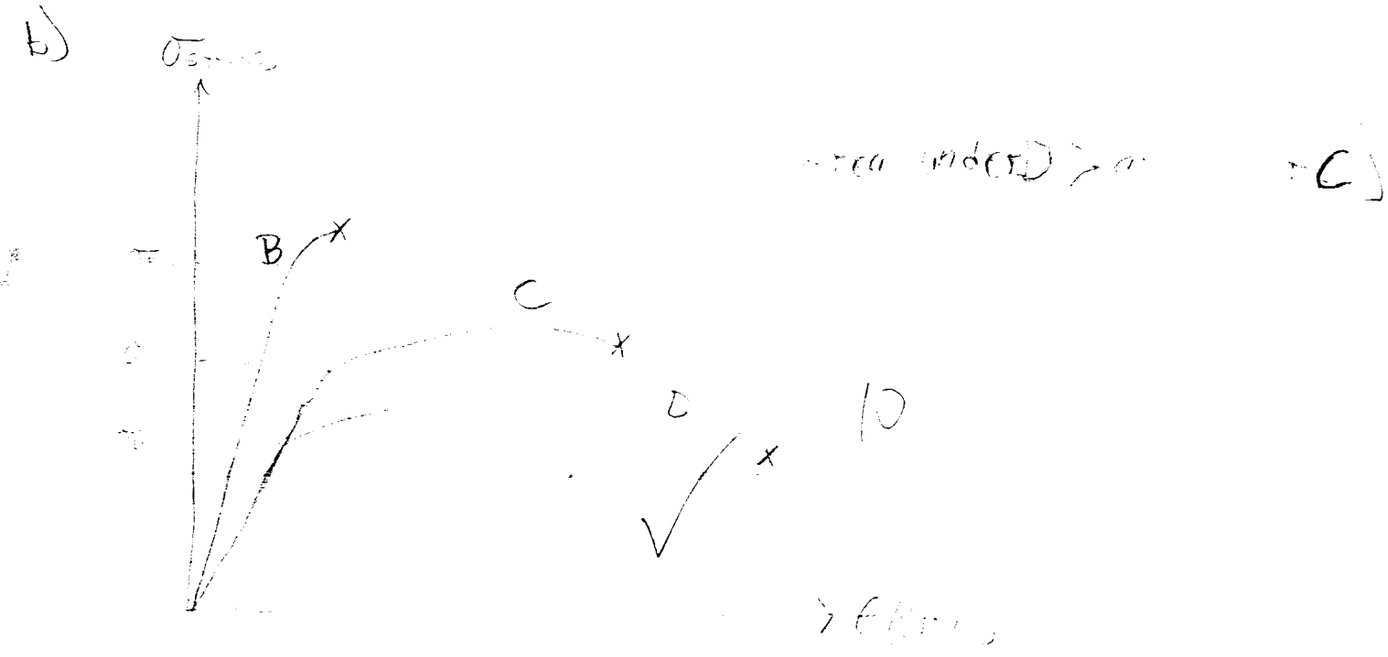
1. (a) Sketch schematically the engineering stress vs. engineering strain, and true stress vs. true strain behavior of an aluminum alloy specimen under a tension test (use the same σ–ε axes for both). Assume the specimen is eventually fractured. Identify on your sketches, the elastic region, 0.2% offset yield strength, plastic deformation region, tensile strength, the onset of necking, and fracture.

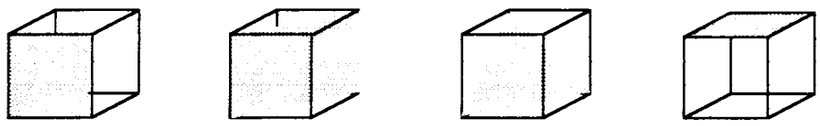
(b) Sketch schematically, <u>all on the same graph</u>, the stress vs. strain behavior of three different metals labeled as B, C and D that have the following properties.

B is brittle but C and D are ductile.
B is the strongest (highest strength).
D is more ductile than C
C is stronger than D
D is tougher than C.





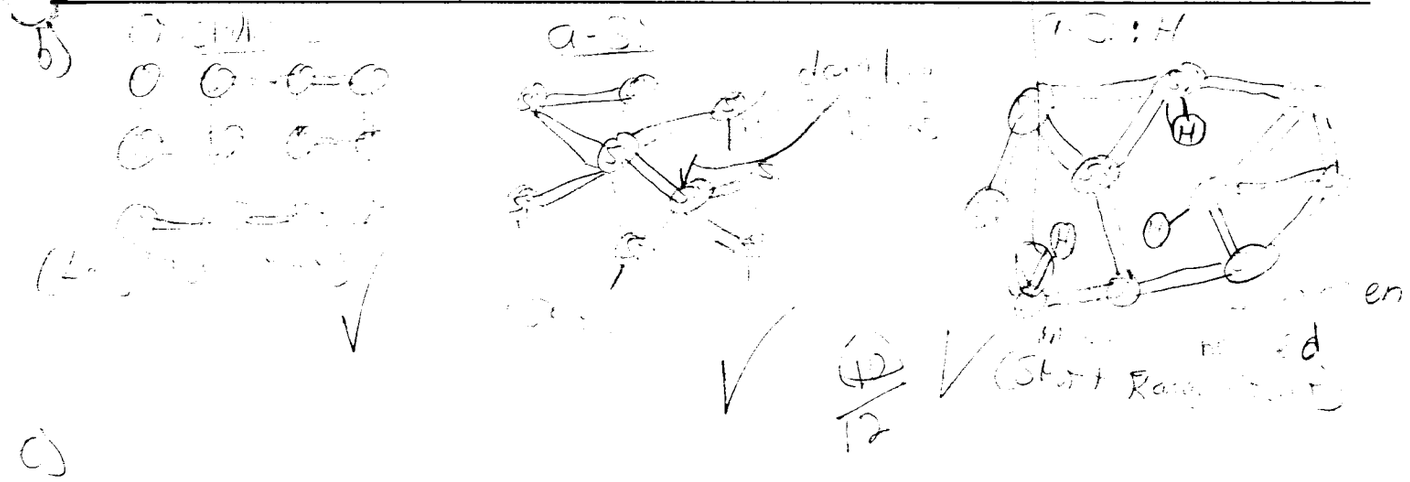
2. (a) Figure Q.2 (a) to (d) show atomic planes in a cubic crystal. For each of the planes find the corresponding miller indices.

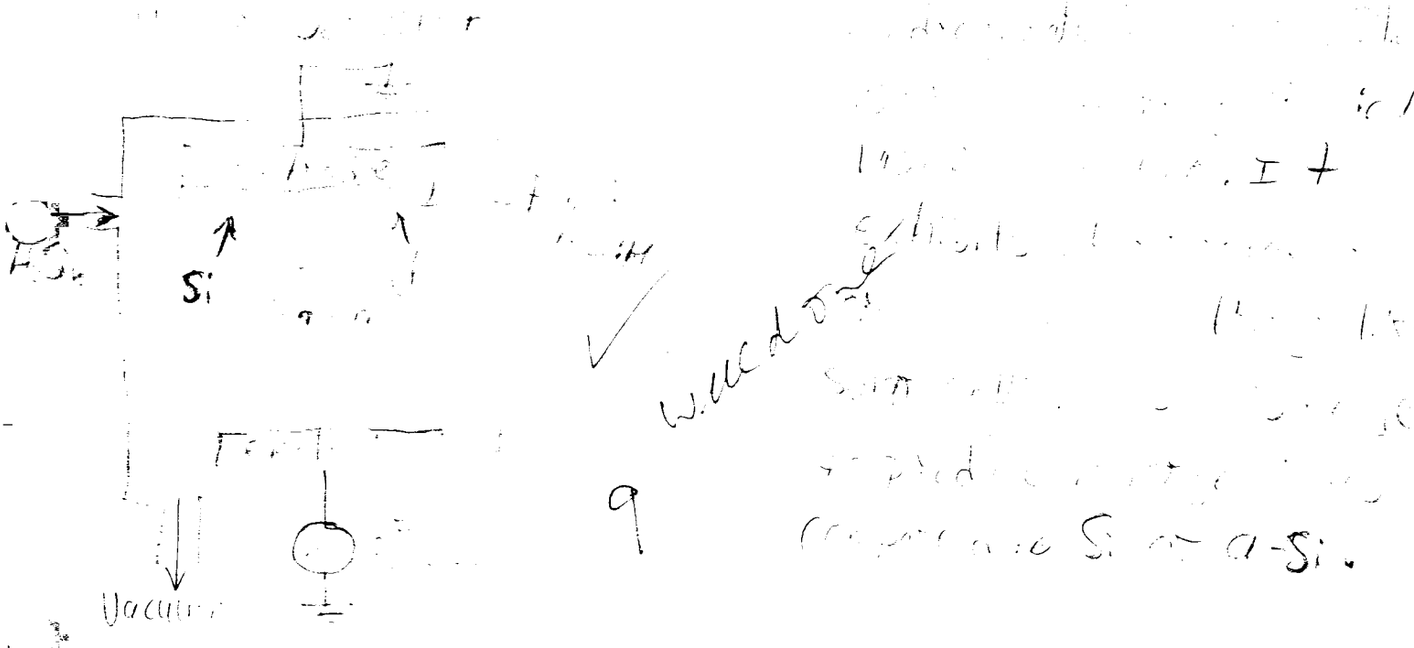


(a) (b) (c) (d)

(b) Sketch schematically in two-dimensions the structure of
- (i) Crystalline Si
- (ii) a-Si
- (iii) a-Si:H

(c) Explain briefly with a clear diagram how a-Si:H is fabricated and its properties and uses.





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3. Sketch schematically the following in a crystal:

(a) A vacancy. What is the significance of vacancies?

(b) A large substitutional impurity and a small substitutional impurity.

(c) An interstitial impurity.

(d) Sketch schematically an edge dislocation in a crystal.

(e) Sketch schematically Schottky and Frenkel defects in an ionic crystal (e.g. NaCl).

(f) Two possible (but distinctly different) ionized substitutional impurity defects in an ionic crystal.

Sketch schematically the structure of

(g) a disordered substitutional solid solution,

(h) an ordered substitutional solid solution,

(i) an interstitial solid solution

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4 Sketch schematically the following

(a) The number of atoms per unit energy vs. energy for gas atoms (e.g. neon gas) in a cylinder at two temperatures T_1 and $T_2 > T_1$. What is the average energy? Identify how you would find the number of atoms with energies greater than E_A? (assume $E_A >>$ average energy).

(b) Consider the x-ray diffraction studies of crystal structures. Explain with clear diagrams, including the diffraction pattern,

(i) the Laue technique, and

(ii) the powdered crystal technique.

(c) Sketch schematically, in two dimensions, the surface of a Si crystal that has not been passivated to show the types of surface defects that exist on the surface of a crystal.